IRD Mechanalysis® Limited

The Vibration People®

IRD306 Vibration Meter
Operation & Maintenance Manual

IRD Mechanalysis Limited
1/5, Marol Co-op Ind. Estate Ltd
Off. M. Vasanji Road, Marol
Andheri (E), Mumbai – 400 059

Tel: 91-22-2852 2906, Fax: 91-22-2852 1814
Email : service@irdmech.com
Web. : www.irdmechanalysis.com

Customer Details
Date Purchased:
IRD Serial Number (s):
P.O. ref:
Organization:
End User:
Sensor Calibration Due:

IRD Mechanalysis Limited

www.irdmechanalysis.com

IRD Mechanalysis Limited continues to be the industry leading provider of Condition Management Solutions. With over 35 years experience in machinery vibration and associated condition monitoring technologies, the company designs and manufactures proven instrumentation suitable for rugged industrial environments. A comprehensive range of products and services are available from the offices below.

Location	Address	Contact Numbers
Delhi	*Sagar Deep, Plot No.11, LSC Saini Enclave, Vikas Marg, New Delhi 110092*	*Tel: +91-011-22373916* *Fax: +91-011-22370778* *Email: mailto:salesNR@irdmech.com*
Kolkata	*153/A, 2nd Floor, VIP Road, Kolkata 700 054*	*Tel: +91-033-23559214* *Fax: +91-033-23559214* *Email: mailto:salesER@irdmech.com*
Mumbai	1/5 *Marol* Co-op. *Industrial Estate Ltd,* Off. *Mathuradas Vasanji Road, Marol, Andheri (East), Mumbai 400 059*	*Tel: +91-022-28522906* *Fax: +91-022-28521814* *Email: mailto:sales2@irdmech.com*
Chennai	*7-C Chesney Nilgiri Apartments* 65, *Commander-In-Chief Road Chennai 600 105*	*Tel: +91-044-28230726* *Fax: +91-044-28234702* *Email: salesSR@irdmech.com*
National Service Centre & Works	1/5 *Marol Co-op. Industrial Estate Ltd., Off. Mathuradas Vasanji Road, Marol, Andheri (East), Mumbai 400059*	*Tel: +91-022-28520178* *Tel: +91-022-28596214/6573* *Fax: +91-022-28521814* *Email: mailto:service@irdmech.com* *Email: service1@irdmech.com*

INDEX OF ILLUSTRATIONS

INDEX OF REFERENCE FIGURES		
Figure	**Title**	**Page**
1.	Periodic Vibration measurements save valuable machine downtime	1
2.	Front view of IRD306 Vibration Meter	2
3.	IRD306 Vibration Meter (Velocity Sensor) – standard package	3
4.	IRD306 Standard accessories	4
5.	IRD544 Inductive Velocity Sensor	5
6.	A typical vibration measurement datasheet	8
7.	IRD General Machinery Vibration Severity Chart (Metric)	10
8.	Discrete machine frequencies show different defects	11
9.	Step by step balancing vector diagram construction	15
10.	Block Diagram of Calibration Setup for IRD306 Vibration Meter	18
11.	IRD Sensor Calibration Lab	18

INDEX OF REFERENCE TABLES		
Table	**Title**	**Page**
1.	Tentative guide to vibration tolerances for machine tools	9
2.	Dominant machine excitation frequencies and most likely causes	12

TABLE OF CONTENTS

SNo.	Chapter description	Page Number
1.	**INTRODUCTION**……..	1
	1.1 Purpose and scope of manual	

Getting you Started

2.	**DESCRIPTION**……..	2
	2.1 General	
	2.2 Standard package	
3.	**OPERATIONS**……..	6
	3.1 General	
	3.2 Preparing the IRD306 for use	
	3.3 Taking Vibration Measurements	
	3.4 Measuring Displacement	
	3.5 Measuring Velocity	
4.	**APPLICATIONS**……..	8
	4.1 Preventive Maintenance	
	4.2 Incoming Inspection	
	4.3 Field Service	
	4.4 Final Assembly Testing	
5.	**VIBRATION TOLERANCES**……..	9
6.	**DOMINANT FREQUENCY**……..	11
7.	**BALANCING**……..	13
8.	**FIELD MAINTENANCE**……..	16
	8.1 Operation Test of Batteries	
	8.2 Operational Test of Sensor, Sensor Cable and Meter Circuit	
9.	**CALIBRATION**……..	17
	9.1 Sensor Sensitivity	
	9.2 IRD306 Calibration Procedure	
	9.3 Sensor Calibration	
10.	**SPECIFICATIONS**……..	20
	10.1 IRD306 Vibration Meter (Velocity Sensor)	
	10.2 IRD544 Inductive Velocity Sensor – Portable Measurement IRD544	

TABLE OF CONTENTS

(Continued)

SNo.	Chapter description	Page Number
	Keeping you Going	
11.	**SUPPORT SERVICES……**	22
	Taking you Further	
12.	**VIBRATION BASED CONDITION MONITORING SOLUTIONS...**	26

MANUAL MODIFICATION

NOTE: Applicable only for model IRD306 bearing Serial Number with Suffix 'C'

The model IRD306C now uses Nickel Cadmium batteries capable of charge discharge cycles in normal operation. To obtain optimum performance and battery life the following care should be taken:

1. Maintain batteries fully charged and avoid complete discharge.
2. Recharge after each use and before storing.
3. Recharge once each month, even if the Vibration Meter has not been used.
4. Recharge (14-18 hrs.) if Amplitude meter reads less than 0.8 on 0-1 scale.

1. INTRODUCTION

1.1 Purpose & Scope of Manual

This instruction manual describes the IRD Mechanalysis model **IRD306 Vibration Meter (Velocity Sensor)**. Also included in this manual are complete instructions on the preparation, setup and operation of this instrument. Specifications of the IRD306 meter and the standard accessories are provided in the subsequent chapters. Information on the significance of the measured vibration amplitude levels in displacement, velocity and acceleration are provided in the guideline severity charts attached at the end of the manual.

Condition in a machine that eventually causes breakdown and unnecessary repairs can be detected early by periodic vibration checks (Figure 1).

Figure 1 Periodic vibration checks can avoid costly machine breakdown

This growth in the severity of mechanical deterioration in a machine could be revealed by increase in vibration levels. The portable self-powered model IRD306 Vibration Meter (Velocity Sensor) provides the consistent means for making these important measurements. This vibration meter measures machinery vibration in terms of Displacement (microns) and Velocity (mm/sec) covering most machinery faults. This rugged and proven portable vibration meter has been in use worldwide for over 30 years. Over this time its circuitry has been enhanced to ensure stability, accuracy and the highest reliability.

Getting you Started

2. DESCRIPTION

2.1 General

Thank you for investing in this **IRD Mechanalysis Vibration Meter**. We trust that like many thousands of users before you will continue to enjoy optimum value from your wise investment. IRD Mechanalysis Limited (IRD) is an independent System Integration Company that designs and manufactures condition monitoring system solutions.

The battery-operated model IRD306 Vibration Meter (Velocity Sensor) uses the latest proven solid state circuitry to provide accurate measurement vibration over the frequency range of 300 to 240,000 CPM.

Figure 2 Front view of IRD306 Vibration Meter (Velocity Sensor)

All of the controls of the instrument are on the front panel and are shown in Figure 2. Brief description is as follows:

A Amplitude Meter

The AMPLITUDE METER indicates the peak-to-peak Displacement or peak Velocity of vibration. The METER has two scales, 0 to 1.0 and 0 to 3.0. The scale used to read the vibration amplitude is determined by the position of the AMPLITUDE RANGE SELECTOR.

B **Displacement velocity selector**

Either the Displacement or Velocity of the vibration may be chosen for measurement. Displacement is indicated on the Meter in micrometers. Velocity is indicated in millimetres per second.(pk)

C **Amplitude range selector**

The AMPLITUDE RANGE SELECTOR determines the full-scale meter range.

Full-scale amplitudes from 3 to 3000 (Micro-meters or millimetres per second) are covered in seven ranges 0 to 3, 0 to 10, 0 to 30, 0 to 100, 0 to 300, 0 to 1000, and 0 to 3000. Positions marked 3000, 300, 30 and 3 are used with the bottom meter scale (0 to 3.0). Positions marked 1000, 100 and 10 are used with the top meter scale (0 to 1.0). Each position indicates the full scale range of the meter for that setting.

D **Vibration sensor receptacle**

The vibration sensor receptacle receives the connector on the Sensor cable from the vibration sensor.

2.2 Standard package

The standard package for the vibration meter is shown in Figure 3. The standard accessories which come along with the meter is depicted in Figure 4 and listed in the table that follows.

Figure 3 IRD306 Vibration Meter (Velocity Sensor) – standard package

Figure 4 IRD306 Standard accessories

Standard Accessories	Qty	Part Number (P/N)
Inductive velocity sensor model IRD544 - 42.5mV/mm/sec, top connector	1	M45260
Cable Assembly for model IRD306/306C to IRD544 Velocity Sensor - 1.2m (4ft), rubber insulated, shielded.	2	M24820
Straight Probe for Sensor	1	M11030
Carrying Case	1	M50120
Battery Set, 2 Nos. of 9V, 100mAH Dry Cells	1	M30642
Manual Operating	1	M43080

The optional accessories are listed below:

Optional Accessories	Part Number (P/N)
Magnetic Holder for model IRD544 Sensor	M43320
Shaft stick for sensor model IRD544 / IRD511 / IRD521 / IRD531	M24750
Magnetic Shield for IRD544 Sensor	M60017
Manual Training– IRD Mechanalysis Vibration Technology 1 (MVT1)	M51001

A brief description of the standard accessories is provided below.

A) IRD544 Inductive Velocity Sensor

The IRD544 vibration sensor, as shown in Figure 5, is a rugged industrial vibration measuring sensor for use with portable measuring instruments. In production for over 35 years it continues to be the World's most widely used velocity sensor. Indian industry alone has more than 6000 in daily use. The model IRD544 is one of the most reliable and environmental resistant sensors in

industry today. The aluminium housing is waterproof, dustproof and acceptable for use in Division 2 hazardous areas and operates up to 260ºC.

Figure 5 IRD544 Inductive Velocity Sensor

The inductive velocity transducer operates with a moving coil in a permanent magnetic field with eddy-current damping. It is suitable for a wide variety of manual and continuous monitoring applications due to its high output, low impedance, good frequency response and high operating temperature.

The sensor connects to the IRD306 meter through the assembled Sensor Cable to an IRD socket on the top end of the instrument. Once a sensor is plugged in, turn the meter 'ON' and agitate the sensor to ensure the system is operating properly.

Note:
That without a sensor connected a residual reading might be shown due to stray Sensor.

B) IRD544 SENSOR CABLE 1.21 M – 2 NOS.

The sensor cable connects the VIBRATION SENSOR to the INPUT RECEPTACLE of the instrument. Belden #8401 cable and MS 3106A- 10SL-4S Amphenol connectors are used.

C) STRAIGHT PROBE

The Straight Probe is provided to reach out-of-the-way places and is screwed into the end of the IRD544 sensor with the ¼" – 28 UNF x 3/16" stud.

D) Battery Set, 2 Nos. of 9V, 100mAH Dry Cells

E) CARRYING CASE (Not shown)

The CARRYING CASE is a rugged and reliable case having storage provisions for the instrument and all its standard accessories.

3. OPERATIONS

3.1 GENERAL

One purpose of the Vibration Meter is to measure machinery vibration for comparison with vibration standards. When the vibration shows an increase or exceeds allowable limits then trouble is present. Since vibration is usually the result of troubles such as unbalance, misalignment, looseness, or bad bearings, the logical place to put the sensor for vibration measurement is on each bearing housing of the machine, or if a bearing housing is not accessible, and then put the sensor on the machine structure nearby.

3.2 PREPARING IRD306 FOR USE

1. Screw the straight probe into the model IRD544 Vibration Sensor.

2. Connect one end of the sensor cable to the sensor and the other to the IRD306 sensor input receptacle.

3. Test the batteries. Turn the amplitude range selector to test position. This turns the instrument on. Displacement-Velocity Selector may be in either position. Good batteries read 0.8 or above on the 0 to 1 scale of the Amplitude Meter. (Refer to the Field Maintenance Section for further information on batteries). Approximately 10 seconds are required for warm-up after turning the instrument on. After that time the unit is ready for use.

3.3 TAKING VIBRATION MEASUREMENTS

Place the vibration sensor on the machine in the vertical, horizontal and axial position at each bearing point. The sensor should be held firmly against the machine with just enough pressure to prevent the straight probe from chattering. Hold the sensor perpendicular to the shaft of the machine. Axial measurements are taken with the long axis of the sensor on the bearing housing parallel to the shaft centreline.

Starting at the least sensitive full scale range, turn the Amplitude Range Selector clockwise to each position until a reading of at least 1/3 full scale is obtained on the Amplitude Meter. This reading is the overall vibration at the point where the sensor is applied.

The meter has two sets of graduations or scales, the top scale from 0 to 1; the bottom scale from 0 to 3. The setting of the Amplitude Range Selector determines which scale applies. If the setting is 1000, 100 or 10, use the top scale while reading the meter. Placing the decimal point as indicated by the Amplitude Range selected. Thus on the 100 setting, full scale on the meter becomes 100 micrometers or 100 mm per second. 0.6 on the meter becomes 60 micrometers or 60 mm per second. If the Amplitude Range Selector is set on 3000, 300, 30 or 3, use the bottom scale, placing the decimal point in the same way. The indications are in micrometers displacement or millimetres per second velocity depending on the position of the Displacement Velocity Selector.

Vibration measurements taken with the model IRD306 are overall vibration readings. Overall readings are the vector sum of all the vibrations at the point the sensor is applied. Overall vibration readings are used for comparison with previous readings to detect an increase that may mean trouble is present or for comparison with previously established standards.

3.4 MEASURING DISPLACEMENT

Vibration can be measured in terms of how far the part moves back and forth. This is called the peak-to-peak displacement or simply the displacement. The model IRD306 measures this displacement in micrometers. One micrometer equals one thousandth of a millimetre.

3.5 MEASURING VELOCITY

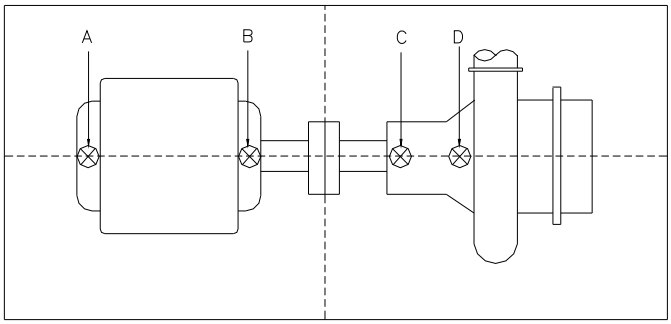
The model IRD306 can also measure the vibration in terms of how fast the part moves. This is called the peak velocity and is measured in millimetres per second. Because velocity is a function of both displacement and frequency, it provides an added sensitivity to high frequency vibrations.

For instance, a vibration displacement of 10 micrometers results in the same meter reading when the frequency is 1800 CPM as it does at 18,000 CPM. The corresponding vibration velocity is 1.0 mm/sec at 1800 CPM but at 18,000 CPM the velocity is ten times as large i.e. 10mm/sec. This means that small vibration occurring at high frequency is easier to detect if velocity measurements are used. Since machine faults such as bad bearings and gears cause vibration at high frequency, velocity measurements are extremely valuable. Displacement or velocity measurements are selected by the Displacement-Velocity Selector.

4. APPLICATIONS

4.1 Preventive Maintenance data sheet

The most useful application of the Vibration Meter is making periodic vibration checks for preventive maintenance purpose. Many companies rely on the detection of a vibration increase as an early symptom of wear or mechanical trouble. By detecting such a condition early, repairs can be scheduled at a convenient time. Thus maintenance costs and down time are reduced and product spoilage minimized. Periodic vibration checks are recorded on a preventive maintenance data sheet like the one shown on Figure 6.



CHECKED — PERIODIC VIBRATION CHECKS — PERIOD : WEEKLY

DISP.:____ VEL.: ____ ACCEL.:____ — VIBRATION TREND CHART (0 2 4 6 8 10)

DATE	BY	A(H)	B(H)	C(H)	D(H)	E( )	F( )	G( )	H( )
1/22	CJ	0.19	0.15	0.21	0.12				
1/29	CJ		0.14	0.21					
2/6	CJ		0.15	0.22					
2/19	CJ		0.18	0.3					
2/20	CJ		0.5	0.6					
2/21	CJ	0.12	0.11	0.19	0.10				
2/22	CJ		0.10	0.13					
3/2	CJ		0.11	0.14					
3/9	CJ		0.12	0.16					
3/19	CJ		0.13	0.16					
3/28	CJ		0.17	0.22					
3/30	CJ		0.20	0.34					
4/8	CJ		0.23	0.29					
4/15	CJ		0.26	0.33					

MACHINE: 12 BOILER FEED PUMP
LOCATION: LOWER LEVEL
OPERATING COND.: NORMAL

INITIAL VIB. LEVELS DISP.:____ VEL.: ACCEL.: ____

	A	B	C	D	E	F	G	H
HORIZONTAL (H)	.19	.19	.21	.12				
VERTICAL (V)	.12	.11	.16	.08				
AXIAL (A)	.08	.08	.11	.08				

VIBRATION LIMITS:
A: 0.6 B: 0.6 C: 0.6 D: 0.6
E: ____ F: ____ G: ____ H: ____

Figure 6 A typical vibration measurement datasheet

4.2 Incoming Inspection

Vibration tolerances are often included in specifications of purchased components to prevent excess vibration in finished products. The IRD306 Vibration Meter is ideal for inspection in receiving or on the assembly line.

4.3 Field Service

Field engineers and service men can quickly determine if vibration is the justifiable cause of a customer complaint. The instrument avoids the expense of more costly equipment and is easily carried to the job.

4.4 Final Assembly Testing

Final vibration checks of finished products and assemblies before shipment assures compliance with production quality standards and customer satisfaction. New or overhauled machines can be checked for vibration from troubles to faulty installation.

5. VIBRATION TOLERANCES

Vibration measurements without a standard for comparison are seldom of any use. There needs to be some guide to show how much is too much. Table 1 provides a guide for Machine Tool Vibrations. The values listed merely indicate the range in which satisfactory parts have been produced. Actual tolerances must be determined by your own experience as to what vibration levels permit the meeting size and finish tolerance.

For General Machinery, the guide shown in Figure 7 may be used. Note the vibration displacement values are for a specific frequency of vibration while velocity readings may be used regardless of the frequency.

Table 1 Tentative guide to vibration tolerances for machine tools

Type of machine	**Displacement of vibration as read with pickup spindle bearing housing in the direction of cut**
Grinders	**Tolerance Range**
Thread Grinder	0.25 - 1.5 microns
Profile or contour Grinder	0.75 - 2.0 microns
Cylindrical Grinder	0.75 - 2.5 microns
Surface Grinder (Vertical Reading)	0.75 - 5.0 microns
Gardner or Besly type	1.25 - 5.0 microns
Centre less	1.0 - 2.5 microns
Boring Mill	1.5 - 2.5 microns
Lathe	5.0 - 2.5 microns

Note:
These values come from the experience of IRD MECHANALYSIS personnel who have been trouble shooting machine tools for over 10 years with the IRD MECHANALYSIS equipment. They merely indicate the range in which satisfactory parts have been produced and will vary depending upon size and finish tolerance.

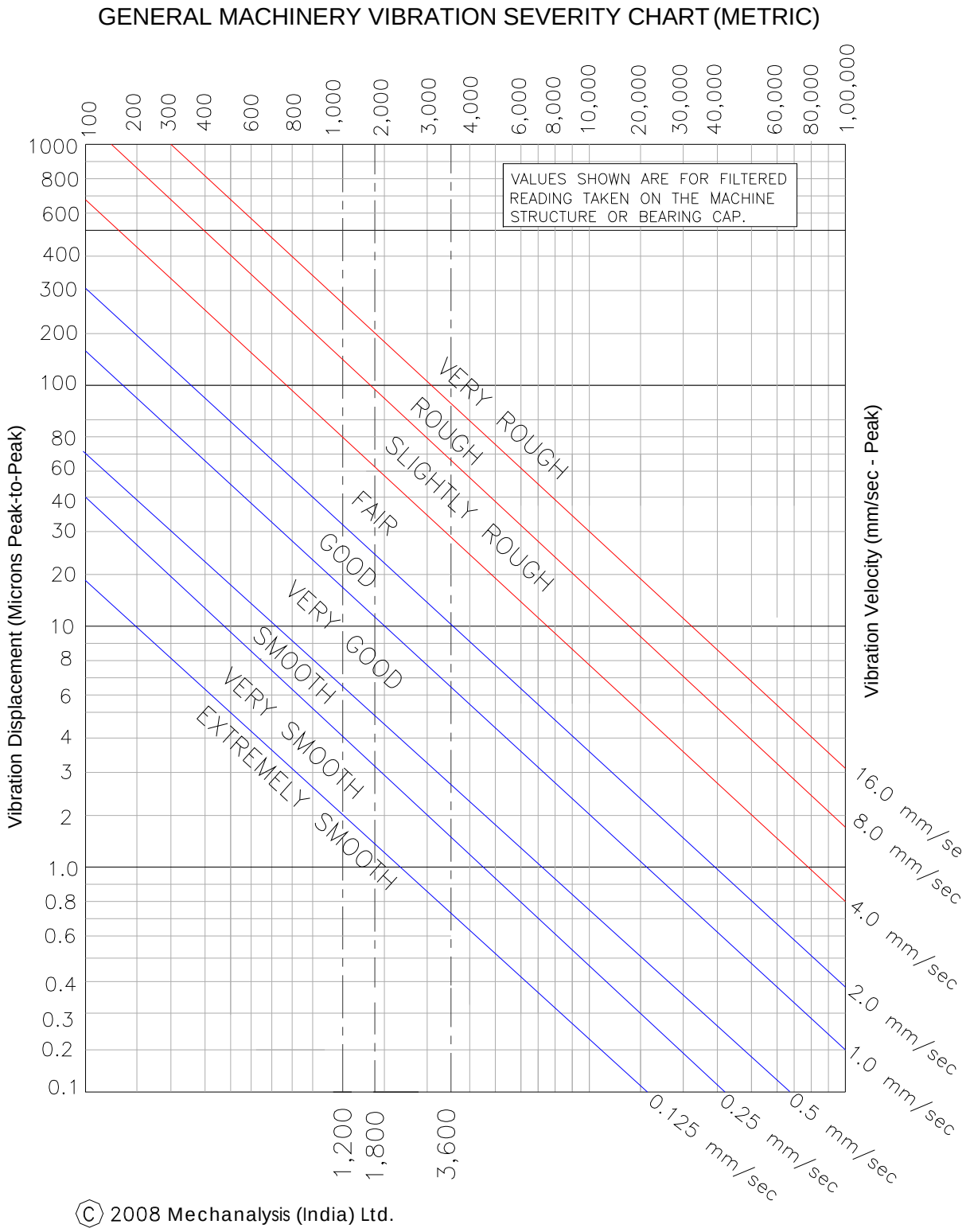


Figure 7 The IRD General Machinery Vibration Severity Chart (Metric)

6. DOMINANT FREQUENCY

It is sometimes useful to know the Dominant Frequency of Vibration of a machine that has several rotating parts, consider, for example, a belt driven blower. The dominant frequency will reveal which part of the machine is causing the most vibration. Vibration measurements taken with the model IRD306 are overall vibration readings or the vector sum of all the vibration at the point the sensor is applied. Measurements taken on the motor bearings would include vibrations of the motor plus vibrations from the fan transmitted through the drive belt and mounting structure. Conversely, measurements taken on the fan bearings would include vibrations of the fan plus vibrations transmitted from the motor (See Figure 8). In many cases the point with the most vibration would pinpoint which part has the trouble, but not always.

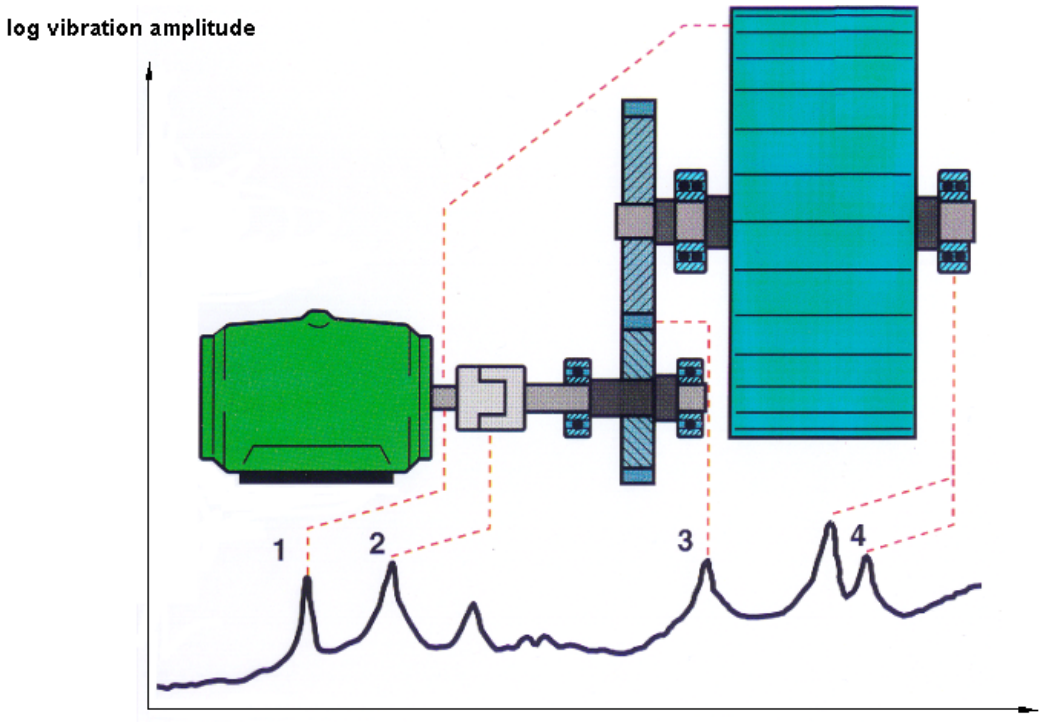


Figure 8 Discrete machine frequencies show different defects

The model IRD306 can be used to find the dominant frequency of vibration provided the readings taken are steady, i.e. the meter pointer does not fluctuate more than about 10%.

Use the following sequence to find the dominant frequency.

1. Measure and record the displacement (D) at a given point.

Be sure to use the exact same measuring point holding the sensor steady for both the displacement and velocity readings.

2. In the same manner and at the same point, measure and record the velocity (V)

3. The Dominant Frequency can be found by dividing the velocity measurement (V) by the Displacement Measurement (D) and multiply by the constant 19.120. The answer will be the Dominant Frequency of Vibration is cycles per minute.

Dominant Frequency (CPM) = Velocity V (millimetres/second x 19.120 (Metric units)
Displacement (D) micrometers

For example, in Figure 8 if the motor runs at 1,750 RPM and the fan at 2,600 RPM and if measurements taken on the motor are: displacement (D) = 47 micrometers and velocity (V) = 6.5 millimetres per second. Then the Dominant Frequency is:

(V) 6.5 x 19.120 = 2,644 CPM
(D) 47.

2,644 CPM is nearest the fan speed. The fan is the dominant part and is causing the largest vibration.

Generally the dominant frequency will be equal to the rotating speed of the part causing the vibration, assuming that the trouble is unbalance. In any event the dominant vibration frequency will normally be some multiple of RPM of the part. After determining the dominant frequency, the type of trouble present may be assumed from the following table.

Table 2 Dominant machine excitation frequencies and most likely causes

DOMINANT FREQUENCY	MOST LIKELY TROUBLE
1 X RPM	Unbalance and / or misalignment If axial vibration is large Check for bent shaft or Misalignment
2 X RPM	Looseness, misalignment
3XRPM	Misalignment
Many times RPM	Bad roller or ball bearings or gears
Less than 1XRPM	Oil whirl (Less than ½ RPM)
Synchronous (AC Line frequency)	Electrical problems
2X Synch. Frequency	Torque pulses
Many times RPM (Harmonically related)	Bad gears Aerodynamic forces Hydraulic forces Mechanical looseness Reciprocating forces
High frequency (Not harmonically related)	Bad antifriction bearings

Note:
This table is just a guideline for root cause analysis of a machine problem. There are many other causes of vibration not listed. To pinpoint all but the simplest requires a thorough analysis and interpretation of the vibration patterns of a machine using an IRD Vibration Analyser.

7. BALANCING

In-situ balancing is a routine procedure accomplished quickly and accurately with any IRD Vibration Analyser. With its tuneable filter rejecting all other vibrations, only the one from unbalance is shown on the amplitude meter; simultaneously the strobe light fires on the component part to visually pinpoint the location of unbalance.

When an IRD Vibration Analyser is not available or it is impossible to use a strobe light, the model IRD306 can be used for single plane balancing under the following conditions:

1. UNBALANCE MUST BE THE MAIN CAUSE OF VIBRATION
Check to see if other causes of vibration such as misalignment of couplings or bearings, bent shaft, bad antifriction bearings, bad gears, mechanical looseness, etc are present.

2. VIBRATION MEASUREMENTS MUST BE STEADY
The meter reading must not fluctuate or slowly drift up or down scale more than about 10% of range selected.

3. THE DOMINANT FREQUENCY OF VIBRATION MUST BE THE SAME AS THE RPM OF PART BEING BALANCED

$$\text{Dominant Frequency (CPM)} = \frac{\text{Velocity (V) millimetres/second} \times 19.120}{\text{Displacement (D) micrometers}}$$

If all three of the above conditions can be satisfied, use the following:

PROCEDURES FOR SINGLE PLANE BALANCING

Step1. With the sensor, survey the part to be balanced for a point of maximum vibration.

Step2. Attach the sensor, if possible, at the point of maximum amplitude. If the sensor is hand held make sure it is applied at the same point and in the same direction for all readings.

Step3. Measure and record the original unbalance vibration. Call this reading 0.

Step4. Choose a trial weight. Carefully weigh and record the trial weight (TW).

Step5. Add the trial weight at any location on the part to be balanced and run the machine. Measure and record the vibration. Call this reading (T1).

Step6. Move the trial weight to another location 180° from the first spot and at the same radius. Run the machine. Measure and record the vibration. Call this reading (T2).

Step7. With the above data, the amount of weight and the angular position necessary to balance the part may be determined. A sheet of paper, a ruler, protractor and compass are required.

The sequence of steps is outlined below and the vector diagram drawn in the process is shown in Figure 9.

I Draw a circle with a radius representing the original unbalance vector in micrometers. Then draw a line vertically through the centre of the circle that intersects the circle. The intersection at the top is point A; at the bottom is Point B. See figure 9A.

II Using the same scale, draw an arc with a radius equal to the vibration reading T1. The centre of the arc is at point A. See figure 9B.

III Using the same scale, draw an arc with a radius equal to the vibration reading T2. The centre of the arc is at point B. See figure 9C. Note that arcs T1 and T2 intersect in two places.

IV Draw a line from the centre of the circle to one of the intersections of the two arcs. Using the same scale measure the length of the line in microns. Call this value R. See Figure 9D.

V To determine the correct weight to balance the part, multiply (O) in micrometers by trial weight (TW) and divide by the resultant ® in micrometres.

$$\text{Balance Weight} = \frac{O \times TW}{R}$$

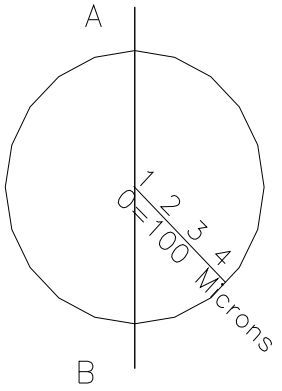
VI To determine the angular location for the balance weight, measure with a protractor the angle between line A-B and line R. Call this angle M. See Figure 9E.

Note:
The actual spot to attach the balance weight is either clockwise or counter clockwise. An angle equal to the measure angle M from the spot where the trial weight was added for reading (T1).

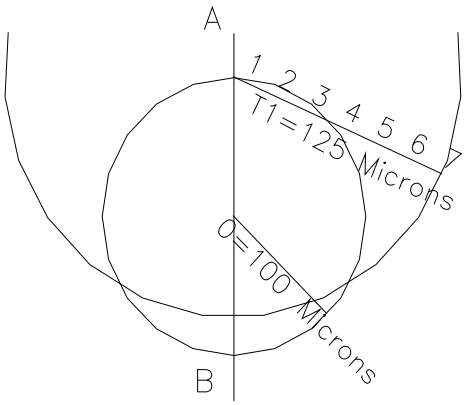
VII Place the balance weight calculated in step V on the part at the measured angle M clockwise from the spot where the trial weight was first added to obtain reading T1. If the vibration reading is not acceptable, move the weight to spot M degrees counter – clockwise from the spot where the trial weight was added to obtain T1.

DATA:

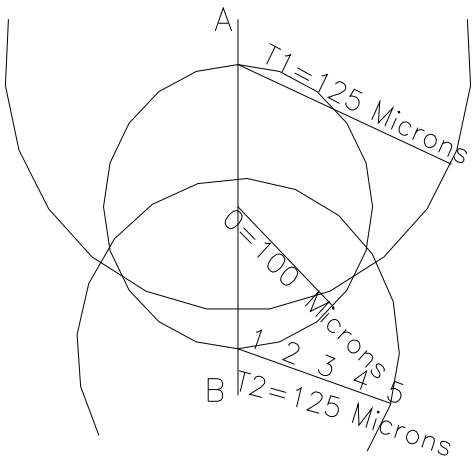
Original unbalance (O)	: 100 Microns
Trial Weight (TW)	: 70 Grams
First Trial Wt. Run (TW_1)	: 125 Microns
Second Trial Wt. run. (TW_2)	: 125 Microns



9A

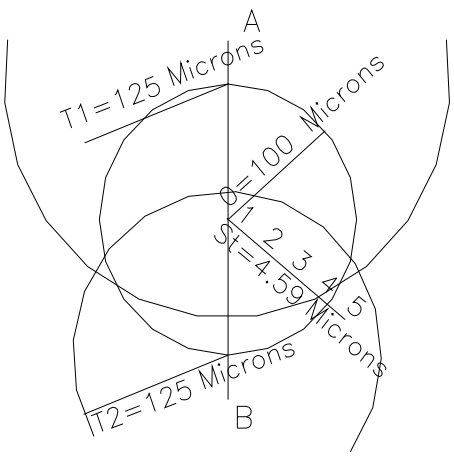


9B

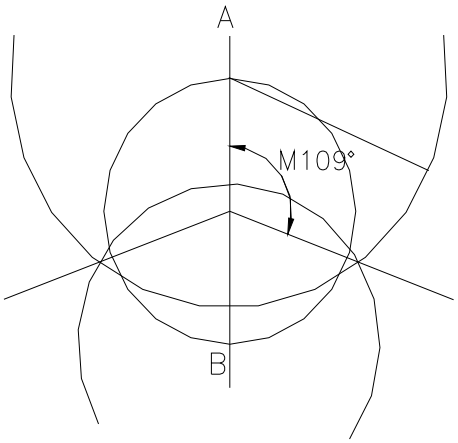


9C

Balance Weight= $\frac{0xTW}{R} = \frac{100x20}{4.59}$



9D



9E

Figure 9 Step by step balancing Vector diagram construction

8. FIELD MAINTENANCE

Field Maintenance of model IRD306 Vibration Meter is limited to malfunctions which can be located and corrected without the use of electronic test equipment.

Simple test and correction procedures are provided in the operation test below. If these tests reveal electronic trouble, the Vibration Meter, sensor and sensor cable should be returned to the IRD Works for repair and calibration. If calibration equipment is available for the instrument, calibration procedure is provided in the next chapter. Prepare the IRD306 for taking vibration measurements as described in Chapter 3. The following tests will help determine if all segments of the instrument are performing their proper functions.

8.1 OPERATION TEST OF BATTERIES

The first position clockwise from the OFF position on the amplitude range switch is the battery test position. Good batteries show 0.8 or above reading on the 0-1 scale (the upper scale only is used for battery test). When the meter indication is below 0.8 in the TEST position, replace batteries. To gain access to the batteries, remove the four screws located on the rear of the instrument. The case containing the batteries will separate from the bezel containing the meter, switches and printed circuit board.

Separate the case and bezel carefully. Do not damage the interconnector wiring. Observe the polarity of both replacement batteries

8.2 OPERATION TEST OF SENSOR, SENSOR CABLE AND METER CIRCUIT

Set the amplitude range selector to “TEST”. Meter should indicate 0.8 or above. If a reading below 0.8 is obtained, see operational test of batteries above. Place the Amplitude Range Selector in the 3000 position and Velocity Displacement Selector in the “Disp” position. Grasp the Sensor in the hand and shake it back and forth. A large amount of movement is not necessary. A short fast shake will give better results. The Amplitude Meter will register more than full scale and the Sensor, Sensor Cable and Meter Circuit are operational.

If not, disconnect the Sensor from the Sensor Cable, turn the Amplitude Range to 3 and insert the end of a piece of insulated wire, which is several feet long, into the “B” contact of the Sensor Cable connector. Turn the Amplitude Range Selector clockwise until a substantial meter reading is obtained. The amount shown on the meter depends on the amount of stray electrical energy in the area the test is being made. The meter will indicate higher if the test is being made close to a florescent light fixture. Conversely the meter may not indicate at all if the test is made in an open field with no power lines close by.

The meter should indicate zero when the other end of the test wire is inserted into pin ‘A’ of the sensor receptacle. If it does not, then the Sensor is probably inoperative.

If the preceding tests are made close to an operating florescent light fixture and no meter indication is obtained, disconnect the Sensor Cable from the meter. Set the Amplitude Range Selector to the ‘3’ Position. Touch pin ‘B’ of the sensor receptacle with the end of the Test Wire. If the Meter indicates and goes to 0 when the other end of the test wire is touched to pin ‘A’, Suspect? The Sensor is probably inoperative. If the test is made close to a florescent light fixture and no meter indication is obtained, Suspect? The meter circuit is probably not functioning.

9. CALIBRATION

The calibration procedure described herein is supplied for the customer information. No attempt to disassemble or calibrate the unit should be made except by an experienced, qualified technician using the proper test equipment. IRD Mechanalysis assumes no responsibility for the operation of instruments repaired or calibrated outside IRD or at an unauthorized service centre.

The following test equipment is required:

1. Multi-meter

2. Signal Generator

3. Frequency Counter

9.1 SENSOR SENSITIVITY

On IRD544 Inductive Velocity Sensors with serial number prefix “C” or later, the last three figures will be the milli volt level used for calibration of both Displacement and Velocity at 100 cps. On IRD544 Sensors, which have a calibration sensitivity label applied, the noted sensitivity will be the milli volt level used for calibration of both Displacement and Velocity at 100 cps. On sensors that do not have the sensitivity noted, the sensitivity can be obtained by contacting IRD Mechanalysis Ltd. State Sensor serial number and model number, or if extreme accuracy is not needed, 240 mV can be used. This figure represents the model IRD544’s output at 100Hz at a 1 mil shake (.314 in/sec at 100 Hz –10%).

9.2 IRD306 CALIBRATION PROCEDURE

The procedure for calibrating the model IRD306 is as follows:

1. With the instrument turned OFF, Zero the AMPLITUDE meter using the small adjusting screw located on the front face.
2. Switch the AMPLITUDE SWITCH to TEST. Meter should read between 0.8 and slightly off scale. If not, replace batteries.
3. Turn the AMPLITUDE RANGE switch to the 30 position. Turn the Disp-Vel switch to Disp.
4. Apply a signal to the input connector (See Figure 10)
5. Adjust the oscillator output to the sensor output sensitivity.
6. The Amplitude Meter should now read 25.4 on the 30 micron scale. If it does not, disassemble the instrument and adjust the GAIN CALIBRATE (R1) CONTROL until a 25.4 reading is obtained.
7. Place the Disp-Vel selector switch to Vel position and amplitude range switch to 10 range. With same signal input (Step 5) adjust the VELOCITY CALIBRATE CONTROL (R2) for a reading of 0.8 on the 0-10 micron scale.

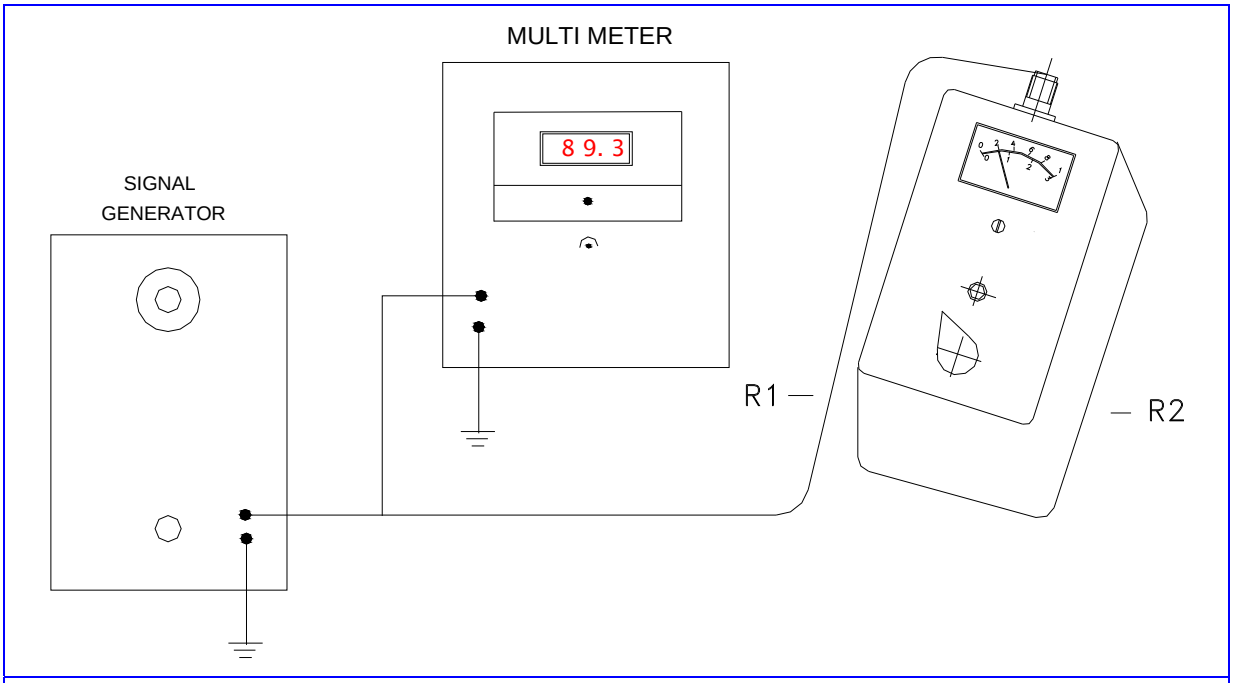


Figure 10 Block Diagram of Calibration Setup for IRD306 Vibration Meter

9.3 SENSOR CALIBRATION

The calibration of the IRD544 sensor can be done at the state of the art Calibration Lab at IRD Works, Mumbai (Figure 11).

Figure 11 IRD Vibration Sensor Calibration Lab

This Lab has a state of the art TransCal system supplied by Beran Instruments UK. It is an automatic digital full frequency sensor calibration system. It undertakes calibration of a sensor throughout its frequency range. The master reference sensor is traceable to National Standards. Calibration Certificates are generated and stored for each sensor tested. IRD has constructed an environmentally controlled Lab for all sensor calibration tests. This service could be availed by all users irrespective of sensor manufacturer. Further details could be obtained from the IRD regional office or IRD Mumbai office.

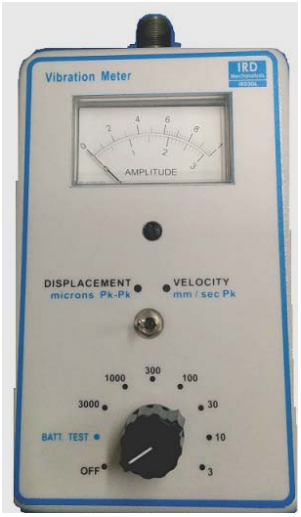
10. SPECIFICATION

10.1 IRD306 Vibration Meter (Velocity Sensor)

Part Number M30601

The IRD Mechanalysis model IRD306 vibration meter measures industrial machinery vibration in terms of Displacement (microns) and Velocity (mm/sec) covering most machinery faults. This rugged and proven portable vibration meter has been in use worldwide for over 45 years. Over this time its circuitry has been enhanced to ensure stability, accuracy and the highest reliability. Supplied with the high temperature IRD544 inductive velocity sensor, it can also be used for balancing machine rotors applying the 'Three Point Balancing Method'.

BILL OF MATERIALS	Qty	Part Number (P/N)
IRD306 Vibration Meter (Velocity Sensor)	1	M30601
Sensor inductive velocity model IRD544 42.5mV/mm/sec, top connector	1	M45260
Cable Assembly for model IRD306/306C to IRD544 Velocity Sensor - 1.2m (4ft), rubber insulated, shielded	2	M24820
Magnetic Portable Base, model IRD544 Sensor	1	M24823
Stinger, Al 225mm long for Sensor	1	M24827
Carrying Case for model IRD306 / IRD306C	1	M25349
Battery Set, 2 Nos. of 9V, 100mAH Dry Cells	1	M30642
Manual Operating	1	M43080
Optional Accessories		Part Number (P/N)
Shaft Fish Tail Stick - Absolute Vibration for IRD544		M24824
Magnetic Deflecting Shroud for IRD544 Sensor,		M24825
Manual Training– IRD MVT1		M51001



SPECIFICATIONS

Measurement Ranges 7 Overlapping
Displacement: - 0 – 3,000 microns Pk to Pk
Velocity: - 0 – 3,000 mm/sec Pk
Frequency Range
Displacement: - 300 to 24,000 CPM (5 Hz to 400 Hz)
Velocity: - 300 to 150,000 CPM (5 Hz to 2,500 Hz)
Accuracy
Instrument: - 1.0 % of full scale
Input : Inductive Velocity Sensor IRD544 Calibrated to National Standards
Output : Analog Moving Coil Meter display
Power Requirements
Internal Battery - Battery Set, 2 Nos. of 9V, 100mAH Dry Cells
Environmental
Operating temp: - 0°C to +55°C
Storage temp: -18°C to +60°C
Weight & Dimensions
Instrument: - 184mm (L) x 114mm (W) x 83mm (H)
Carrying case: - 195mm x 185mm x 110mm
Instrument with batteries: - 0.8 Kg
Carrying Case: - 2.4 Kg (including meter and standard accessories)

The Vibration People of IRD Mechanalysis can be contacted at the following branches or your local distributor:

Mumbai	Delhi	Kolkata	Chennai	International
Tel: +91(0)22-2852-0178 Fax: +91(0)22-2852-1814 sales@irdmech.com Service@irdmech.com	Tel: + 91(0)11-2237-3916 Fax: +91(0)11-2237-0778 salesNR@irdmech.com	Tel: +91(0)33-2355-2062 Fax: +91(0)33-2355-9214 salesER@irdmech.com	Tel: +91(0)44-2823-0726 Fax: +91(0)44-2823-4702 salesSR@irdmech.com	Tel: +91-22-2852-0178 Fax: +91-22-2852-1814 sales@irdmech.com Service@irdmech.com

IRD® is the Registered Trademark of **IRD Mechanalysis® Ltd**

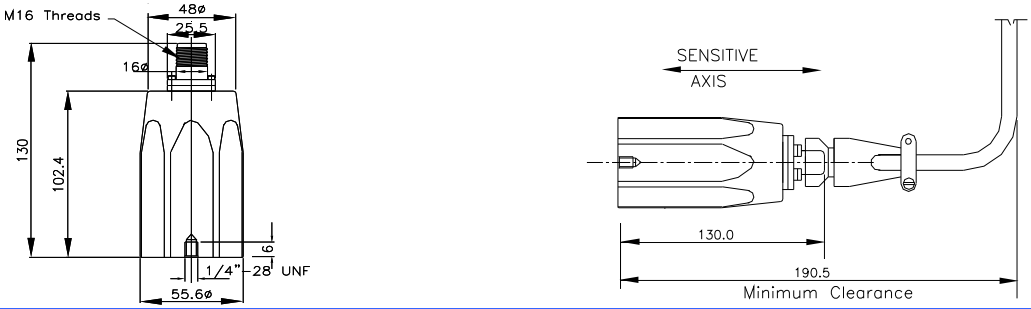
10.2 IRD544 Inductive Velocity Sensor – Portable Measurement Part Number M45260

The model IRD544 inductive velocity sensor is an industrial vibration measuring device for use with portable instruments and rotor balancing. It is environmental friendly, generating its own power with high sensitivity output and suitable for a wide variety of machinery types, especially where displacement is important.

The sensor is sealed to IP65, approved for use in Class 1, Div 2 hazardous areas and operates up to 260ºC. In production for over 45 years, it continues to be one of the World's most widely used velocity sensors. Calibrated to traceable National Standards, the sensor is supplied with a full frequency calibration test certificate. It can be fully serviced only at the IRD Mechanalysis National Service Centre.

BILL OF MATERIALS	Qty	Part Number
IRD544 Inductive Velocity Sensor	1	M45260
Optional Accessories:		
Magnetic Portable Base, model IRD544 Sensor (recommended for routine portable measurements)	1	M24823
Magnetic deflecting shroud (reduces AC magnetic field by 100:1)	1	M24825
Straight cable 1.2m rubber insulated, shielded. Mil to Mil Connectors for operation at 121°C	1	M24820

Dimensions & Connections



Technical Performance		
Frequency Response	:	14 to 1,000 Hz <8%
	:	10Hz -20% (average) at 21°C
Sensitivity	:	42.52 mV/mm/sec ± 10%
Impedance	:	R=2k ohms, L = 0.7 H at 21°C
Maximum Amplitude	:	3175 microns Pk - Pk to 70 Hz; 30 g above 70 Hz
Transverse Response	:	Less than 5% (average) 10 to 1,000 Hz
Mounting		
Orientation	:	Any (Horizontal Vertical or Axial)
Mounting	:	¼" - 28 tapped hole ¼ in depth
Grounding	:	Case and signal ground common
Connector	:	2-pin Mil Spec
Environmental		
Operating range	:	-40°C to 260°C
Housing	:	Aluminium, IP65 sealed
Classification	:	Class1, Div2
Weight & Dimensions		
Weight	:	0.65 Kg
Dimensions	:	50.8mm (Hex) base x 130 mm (H)
Construction	:	Aluminium

The Vibration People of IRD Mechanalysis can be contacted at the following branches or your local distributor:

Mumbai	Delhi	Kolkata	Chennai	International
Tel: +91(0)22-2852-0178 Fax: +91(0)22-2852-1814 sales@irdmech.com Service@irdmech.com	Tel: + 91(0)11-2237-3916 Fax: +91(0)11-2237-0778 salesNR@irdmech.com	Tel: +91(0)33-2355-2062 Fax: +91(0)33-2355-9214 salesER@irdmech.com	Tel: +91(0)44-2823-0726 Fax: +91(0)44-2823-4702 salesSR@irdmech.com	Tel: +91-22-2852-0178 Fax: +91-22-2852-1814 sales@irdmech.com

IRD® is the Registered Trademark of **IRD Mechanalysis® Ltd**

IRD Mechanalysis Ltd. continuously improves products; it therefore retains the right to change the above specification without notice

Keeping you Going

11. Support Services

Keeping you going is an IRD Mechanalysis commitment. Product support is an essential aspect of any progressive business. IRD Mechanalysis Limited is no exception; the company has been supporting IRD's products for the past 35 years. Indeed the acceptance and usage of these products by industry is directly attributed to the dedicated support IRD has provided. IRD continues to invest in Customer Support. Just 'keeping you going' is not enough; we have facilities to ensure systems match world standards. Our instruments and systems are calibrated to National Standards.

IRD National Service Centre

The very nature of industrial electronic instruments, both portable and permanent, demands regular calibration. From time to time it becomes necessary to repair of damaged items such as cables, sensors, power supplies and occasionally electronic circuitry etc. Mechanalysis is well equipped for such eventualities

When equipment is in need of repair, a reliable repair centre that is responsive, convenient, and cost effective is required. Mechanalysis (India) Ltd offers in-house as well as site calibration (traceable to National Standards) and repair services. This also covers our partner's product range; IRD also supports many obsolete products where components are still available or have been indigenised.

As the original equipment manufacturer (OEM), we are the most knowledgeable and the qualified to service our products. Supported by more than 50 combined years of technical service experience, our repair technicians provide the highest quality service for your IRD products. At our **National Service Centre** in Mumbai we stock a comprehensive supply of spare parts to ensure a quick turnaround.

BENEFITS and FEATURES

For Mechanalysis (India) Ltd's customers, the **National Service Centre** offers the following:

- Fast in-house turnaround options
- Expert factory technical assistance
- Industry competitive repair charges
- In-house calibration of vibration sensors (traceable to National Standards)
- Regular cleaning and calibration to extend product life and reliability
- Instrument hire during repair period to minimize programme interruption
- 1 Year warranty on Product Exchange Programme
- Fixed Price Repair – Whole Product 3 months warranty
- 90-day parts warranty on all repair and calibration services

PRODUCTS SUPPORTED

The **National Service Centre** has the capability to support the following products:

- Data Collectors: IRD890, IRD Fast Track®, dataPAC®1250, dP1500; Also Commtest VBx series of vibration analysers and profiler
- Portable Instruments: IRD306, IRD306C, IRD306D, IRD306DD, IRD308, IRD350, IRD810, IRD811, IRD811, IRD811D, IRD838, IRD880, IRD885
- Protection Monitors: 5802, 5806, 5815, 5915, 5800 Cards, 6100, 6600 Series, IRD8700 Series, IRD8800 Monitor
- Machinery Diagnostic Systems: IRD9900
- Machinery Protection Transmitters: IRD71000, 7200, 7300, 7400 Series
- Balancing Systems: 245, 246

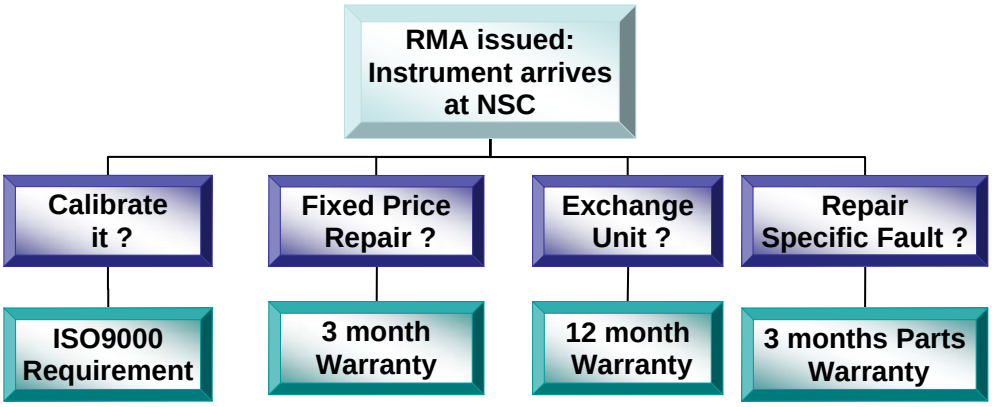
™ dataPAC, and Fast Track are trademarks or registered trademarks of IRD Mechanalysis

Turnaround time and repair capabilities are dependent upon condition of equipment and spare parts availability at the time of the product assessment.

How the National Service Centre Optimises Clients Investments

- Annual Maintenance and Calibration ensures years of trouble free operation to maximize the investment in your condition monitoring equipment.
- A complete in-house supply of spare parts assures quick turnaround for product repairs.
- State of the art Sensor Calibration automatically over the full frequency range traceable and up to date to National Standards of the UK.
- IRD Mechanalysis Ltd ISO 9002 certification guarantees quality repairs and service.
- Our highly qualified Repair Centre technicians, supported by more than 50 combined years of technical service experience, give you the best available service and results.
- As the only authorized service centre for IRD Mechanalysis Ltd Products, our **National Service Centre** provide the most knowledgeable, experienced and committed support for all of our products.
- We offer a IRD Product Exchange Programme, Fixed Price Repair or Standard Repair and Calibration Only Services: the applicable warranty benefits are given below:

Service Options & Process



HOW TO GET SERVICE?

1. Before dispatching any instrument, cable, sensor etc it must be given an RMA number issued by the **NSC,** see below
2. For a Return Material Authorization number (RMA) this can be downloaded from our web site: www.irdmechanalysis.com
3. To discuss any instrument servicing issues please call Tel: +91(0)22-2852-0178 or one of our Regional Offices
4. Alternatively Email us at : service@irdmech.com
5. Complete the RMA and fax back to IRD Mechanalysis at Fax: +91(0)22-2832-1814
6. When the RMA has been issued, the Client sends the instrument with all accessories together with the Purchase Order making reference to the RMA Number.
7. Upon receipt, IRD will evaluate the instrument and make a recommendation to the Client (if no instructions on type of service have been received earlier).
8. Only when the repair has been completed and payment has been received, will the instrument be returned to the Client.
9. Warranties will apply depending on the Repair Category option

LOCATIONS

National Service Centre

1/5, Marol Co-op. Industrial Estate Ltd,
Off. Mathuradas Vasanji Rd,
Marol
Andheri (East)
Mumbai
400 059
INDIA
Tel: +91(0)22-2852-0178
Tel: +91(0)22-2859-6214 / 6573
Fax: +91(0)22-2832-1814
Email: service@irdmech.com
Email: sales@irdmech.com

Head Office (Registered)

47 – 48 Jolly Maker Chambers II
Nariman Point
Mumbai
400 021
INDIA
Tel: + 91(0)22-2202-7430
Fax: +91(0)22-2285-0480
Email: ceo@irdmec.com
www.irdmechanalysis.com

RMA (Return Materials Advisory) Form

ATTN: Mechanalysis (India) Ltd, National Service Centre, 1/5 Marol Co-op, Industrial Estate Ltd, Off Mathurdas Vasanji Road, Marol, Andheri (E), Mumbai 400 059, India. +91(0)22-2852 0178 / 2906

FAX BACK RMA FORM: +91(0)22-2852 1814 or Email to : service@irdmech.com

Product model:	Serial No:
Fault details (if applicable): Please tick appropriate box	

Warranty		Calibration		Fixed Price Repair		Exchange Units		Standard Repair	

This is to advise that we are planning to dispatch the above instrument for Calibration / Repair, as detailed above, on (date):_____

Customer's Purchase Order No:		**Date:**	
P.O. Value: Rs. (if agreed)			
AMC Contract No (if applicable)**:**			

A purchase order must be provided before inspection will commence unless an AMC Contract is in place.

When NSC receives the Return Material Authorisation it will issue an RMA number. Only then send in the instrument with its RMA Nos tagged on the instrument for tracking purposes. A PO must accompany the instrument referencing the RMA Nos.

Please complete the details below to enable us to process your requirements as quickly as possible.

MUST BE COMPLETED IN ALL CASES			
Invoice Address		**Delivery Address**	
Company:		Company:	
Department		Department	
Address:		Address:	
City		City	
State		State	
PIN		PIN	
Contact Name:		**Contact Name:**	
Telephone:		Telephone:	
Mobile:		Mobile:	
Fax:		Fax:	
Email		Email	
		Users Name:	
		Designation	
		Signature	
		Date	

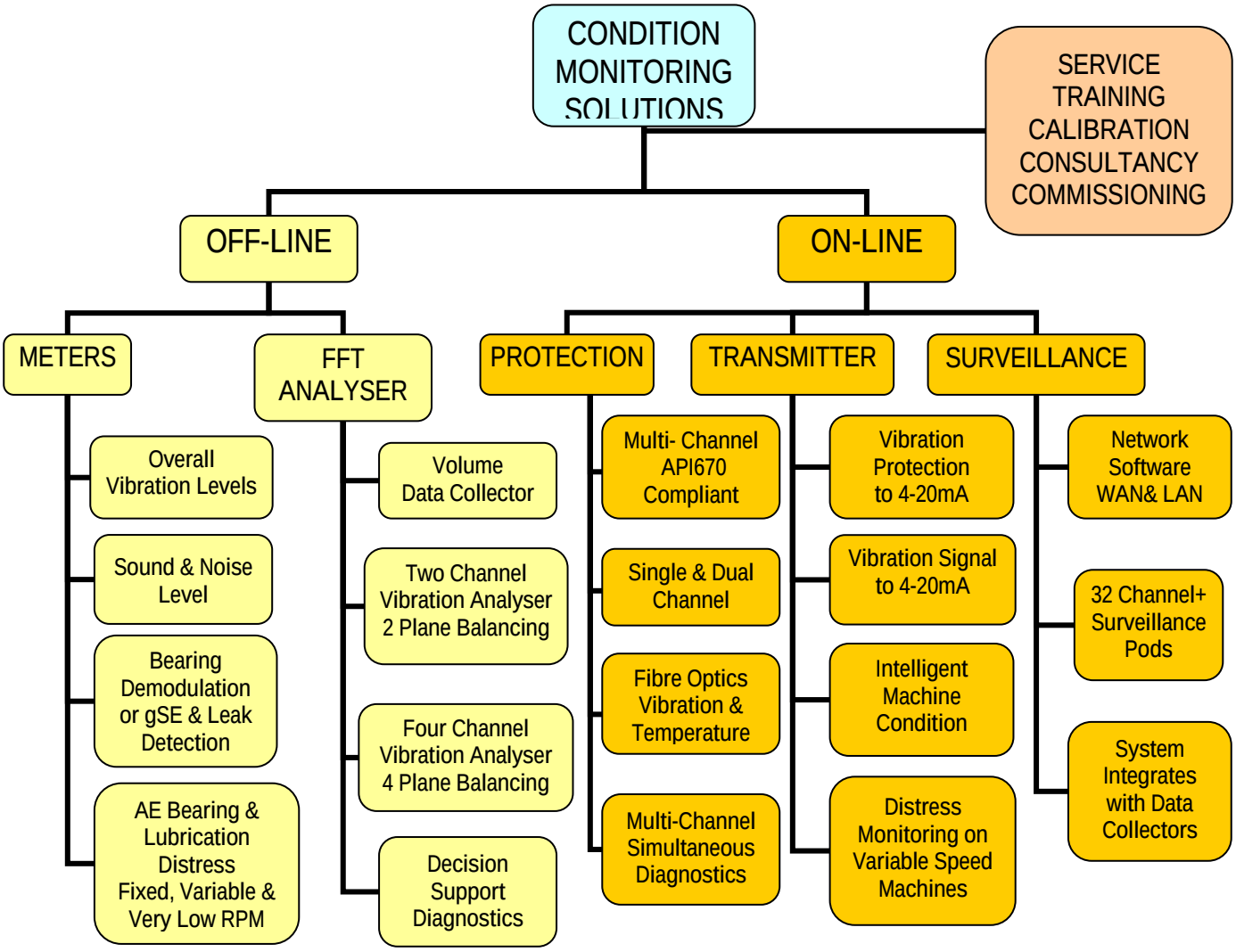
NSC RMA NUMBER ISSUED: RMA/

Taking you Further

12. Vibration Based Condition Monitoring Solutions

IRD Mechanalysis Ltd is a leading provider of condition management solutions with over 30 years experience in machinery vibration measurement. IRD is credited with pioneering the concept of vibration based condition monitoring programmes in India. With the advent of computerisation, IRD has established and maintained over 250 automated vibration based CM systems and has a user base of over 2200 major Producers and OEMs in India. IRD will continue to introduce new technologies to match your needs and reduce the cost of Condition Management. IRD is now rapidly expanding its International Export Division globally.

We take you further by providing reliable, easy to use, rugged and a comprehensive range of vibration monitoring products & solutions (as depicted in the chart below) that enables you to enhance your productivity and investment. We look forward to your continued support and patronage.



****